The Massabesic Experimental Forest

A field laboratory of the Northeastern Forest Experiment Station of the U.S. Forest Service

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by

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WHITE PINE AND FIRE! These two--the tree and its destroyer, fire--are keys to the history and present make-up of the research program on the Massabesic Experimental Forest at Alfred, Maine. The Forest was established in the late 1930's to study the management of eastern white pine. During World War II, it was shut down, and reopened again in 1946. Then, in 1947, the timber on 3,000 of the Forest's 3,700 acres was destroyed in the well-remembered October blow-up of wildfires, which all together seared 150,000 acres in southwestern Maine.

Much of the timber killed in the 1947 fire--nearly 4½ million board feet--was salvaged the following year. The larger trees went into sawlogs, and the smaller ones went into such products as wallboard. In many places within the burn, where the fire had not crowned, a good many trees survived. However, most of this surviving timber on the burn--about 1-3/4 million board-feet--was blown down by storms in 1950 and 1954. This, too, was salvaged.

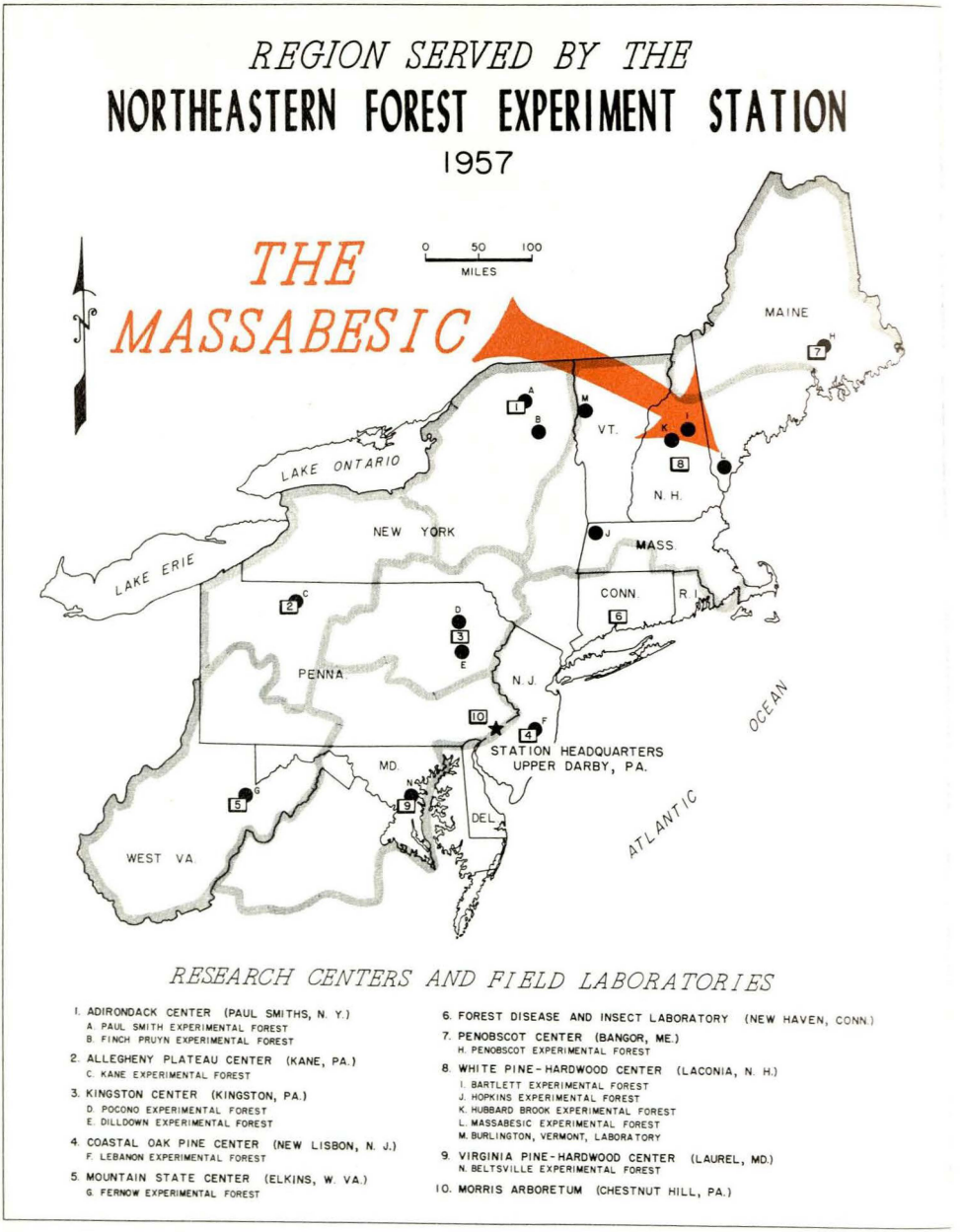
So, between fire and wind, the destruction of the pre-1947 stands on some 3,000 acres of the Massabesic was, by 1954, practically complete. Thus, almost at its outset, the Forest, created to study the management of white pine stands, had to have its goals reset to undertake, as well, the re-establishment of pine on burned-over areas.

The Massabesic

Let's look at the Massabesic Forest as it fits in with the rest of the Federal forest research program in New England.

Land for the Experimental Forest was acquired under the Weeks Act between 1937 and 1942. About two-thirds of it --2,500 acres--was purchased from Bates College. This was part of 10,000 acres willed to the school by Benjamin Clark Jordan, an Alfred lumberman who died in 1912.

The Forest, with headquarters on State Highway 111, is operated by the Northeastern Forest Experiment Station through its White Pine-Hardwood Research Center at Laconia, N. H. The Massabesic is one of four experimental forests which, along with the Burlington, Vt., laboratory, make up this Center. But it is the only unit devoted primarily to white pine studies.



The Massabesic Experimental Forest, located in southwestern Maine, near Alfred, is one of the field laboratories maintained by the Northeastern Forest Experiment Station of the Forest Service, U.S. Department of Agriculture. It is devoted primarily to the study, management, and perpetuation of white pine in the Northeast.

The land of the Massabesic, flat to gently rolling, is between 200 and 450 feet above sea level. Soils are principally stony to very stony sandy loams, ranging to sandy soils on the outwash plains. The growing season averages 178 days--between the last killing frost in the spring and the first in the fall. Temperatures range from a high of 103°F. to a low of -21°. Precipitation, which is rather evenly distributed throughout the year, averages 42 inches.

The White Pine Forests

Eastern white pine thrives throughout New England except under extremes of site--mountain tops, swamps, the driest sand plains. It ranges westward through the Lake States and southward through New York, Pennsylvania, and along the Appalachians to northern Georgia. It is a rapid grower that lives to an old age. At one time fabled 300-year-old pines were common; today such trees are a rarity. Formerly, this species supplied much of the nation's building lumber. Though the wood is only moderately strong, it still finds a great variety of uses because of its smooth grain and soft uniform texture.

To better understand some of the principles of white pine ecology and management, let's go back about 200 years. The region was settled in the early 1800's. Then the average farm was 100 acres--half field and half woodland. Farmers raised cattle, sheep, and produce for the industrial centers along the rivers and streams. Farm woodlands supplied pine for lumber and oak for ship timbers. Frequently hardwoods went into fuel, consumed both on the farm and in the towns. Sheep and cattle browsed the woodlots, reducing growth of hardwood sprouts. In this mode of hardwood removal and grazing, white pine reproduced and remained one of the chief forest species. About 1870, even more land came into pine as residents began to abandon their farms for homesteads in the Midwest. White pine seeded in on the old fields.

In managing for white pine today, we simulate in a general way the conditions of the early farm era. As before, white pine and quality hardwoods are harvested primarily for lumber, although small amounts of pine now go into pulpwood along with low-grade hardwoods; the fuelwood market of the past is being replaced by the pulpwood market of today. Still, as long as hardwoods are removed, the effect in the woods is much the same. To control the sprouts, we now resort to chemicals to do the job once performed by grazing livestock

Today's experiments on the Massabesic cover two broad

White pine, though hard cut for 300 years, is still one of the most important timber species in the Northeast.

areas: rehabilitation of the burned forest, and management studies in the unburned stands. The first program is directed mostly to testing methods of establishing new stands by seeding, planting, and releasing natural softwood reproduction from hardwood sprouts. Studies in the unburned area include harvest-cutting methods in older stands and stand-improvement measures in young growth.

Rehabilitation Studies

Although established young white pines grow best in full sunlight, bare open ground is unfavorable for germination and initial establishment. On areas severely burned in the 1947 fire, few seedlings were evident the next year; either the seed was destroyed, or if not seedlings starting the next spring soon were killed by heat of the sun on the bare, blackened ground. Pine seedlings did become established where some seed was left and there was some vegetation to provide shade.

Then, in a year or two, ground cover developed in such density that it was an obstacle to the seedlings. As a result, over much of the burn, white pine seedlings either failed to start, or started but soon were suppressed by faster growing hardwood sprouts and other ground cover.

Direct Seeding

Direct seeding has been attempted several times since 1947. Airplane seeding of white pine was tried in March 1948. Seedlings did not become established on the severely burned areas where the ground was bare. On areas burned less severely, the seeding resulted in only a moderate increase in stocking--usually in addition to sufficient natural reproduction.

Seeding by hand in 1949 failed because rodents ate the seed. Six years later another seeding test on a scarified area (using screened seed spots) was more successful. However, with such ground preparation and protection, the cost for seeding usually exceeds the cost of planting seedlings.

Beginning in 1958, in cooperation with the Maine Forest Service, a new series of direct-seeding tests were started on nearby private lands burned over in 1957. These tests make use of the promising bird and animal repellents developed by the U.S. Fish and Wildlife Service. In the first test, in March 1958, treated white and red pine seeds

On the Massabesic Forest, as in many other parts of the region, rehabilitation is the major forestry problem.

Above: fire-killed timber. Below: wind storms have blown down more than a fourth of the Forest's timber.

were broadcast on the snow. Additional seeding tests will be made with several species of conifers and a variety of site-preparation measures on three different areas.

Experimental Plantings

Experimental plantings of white and red pine seedlings were first made in the spring after the fire. On areas where timber had been salvaged, pales weevil breeding in pine slash fed on the bark of young seedlings and killed most of them. Seedling survival was good on areas with no pine slash. Plantings in 1949 and 1950 were less successful because of summer droughts. Survival was best where there was some shade--the less severely burned spots. Limited plantings in the fall of 1953 and again the following spring were relatively successful, particularly where a light grass or weed cover was established.

An extensive planting program was started in 1955, and 115,000 pine seedlings were planted in a 3-year period. This brought the total of successful plantings to 200 acres, one-fourth of the area to be planted as a rehabilitation measure. Tree-planting machines have been used on some of the more recent jobs. Two men--tractor driver and planting machine operator--can plant between 2,000 and 6,000 trees a day, depending on ground conditions. This is equivalent to hand planting by an 8-man crew.

Release From Competition

The year of the fire, 1947, was an excellent white pine seed year. Where enough seed trees survived, and where there was a protective ground cover, natural pine reproduction became established. But as new stands of pine seedlings grow, they need to be released from competing hardwood growth. Competitors can be cut back, but this method is expensive and new sprout growth may again overtop the pine. Hardwoods can best be controlled with tree-killing chemicals --silvicides. Experiments on the Massabesic have been made with several chemicals and various methods of application.

Helicopter sprayings of 2,4,5-T have given the best results. Slow-flying and highly maneuverable, these aircraft are ideally suited for spray work where at least 5 acres are to be treated. From 1954 through 1957, yearly applications were made on the Forest. The first--at the rate of 3 pounds acid equivalent of 2,4,5-T and 1-3/4 gallons of fuel oil per acre--proved satisfactory. Later, amounts were reduced to 2 pounds acid equivalent and 2 gallons of fuel oil per acre. This less expensive spray also resulted in adequate hardwood control. Even less 2,4,5-T in the mixture

An extensive planting program is under way. Tree-planting machines have been used for some of the recent jobs.

Some of the plantings have been relatively successful. The red pines shown here are in a 9-year-old plantation.

seems promising, at least under certain conditions. But full extent of kill cannot be determined until at least 3 years after treatment, and the results with less than 2 pounds per acre are still uncertain. Cost of helicopter application of 2,4,5-T is between $7 and $10 an acre.

Other methods of hardwood control with silvicides may be used. For example, basal-stem applications of 2,4,5-T are suitable for small areas or where only a few stems are to be killed. Foliage applications of the silvicides can be made with light-weight mist blowers.

Soil sterilants have also been tried, but the material used was too persistent: seedlings planted 3 years later on treated ground were killed. However, chemicals reputed to be less persistent have recently been developed and may be found useful for hardwood control.

Of the 300 acres of old burn on the Forest that support a fair stocking of white pine seedlings, 200 acres have been released to date. In addition, 280 acres of brush land have been treated to prepare sites for planting. Nearly all this release work has been accomplished by spraying from helicopters.

Management Studies

In 1950, the present programs of management studies were started on the unburned portion of the Forest. Mostly these are long-term comparisons of different methods of cutting and culturing the stands--the so-called compartment studies. However, as time permitted, we have conducted other smaller studies, both on and off the burn. Some, such as the studies of planting and release, have already been mentioned because they apply directly to the rehabilitation job. A few others, such as thinning studies, which apply only to the management of established stands, are briefly described below.

COMPARTMENT MANAGEMENT STUDY

Compartment studies are conducted on areas averaging about 30 acres, a size that permits commercial-scale operations. The study objective is to compare selected management programs over several decades in terms of labor and materials required, quantity and quality of timber yields, and changes in growing stock conditions that affect future productivity.

To free white pines from competing hardwood growth, helicopters have been used to spray chemicals that kill the hardwoods.

Pine has responded well to the release. Here, 4 years after aerial spraying with 2,4,5-T, most of the hardwoods are dead and the pine is growing nicely.

One management program--cutting to a diameter limit--represents about the lowest level of management that will keep an area reasonably productive. Under this program, harvest cuts are made whenever merchantable volume becomes available in trees larger than a specified minimum diameter. The other programs--shelterwood, patch cutting, and strip cutting--represent higher management intensities. In these the objective is to produce high-quality white pine in volumes commensurate with the costs incurred. The essential differences among these programs are in the methods of regeneration employed and in the intensity of stand-improvement practices applied.

Diameter-Limit Cutting

One compartment is managed by a diameter-limit method; it will be cut whenever there is enough volume in trees bigger than 12 inches d.b.h. (diameter breast high--4.5 feet above ground line) to justify a logging operation. The smaller trees are left to grow and to provide seed and shelter for reproduction. Requirements for labor and technical supervision are low: trees need not be marked for cutting; no special work is done to encourage reproduction or to improve the composition and quality of the remaining stand; and only normal care is taken to avoid logging damage to the stand left.

This compartment was cut in 1956. The harvest was 4,800 board-feet per acre; the stumpage value amounted to $121 per acre. Just when the next cut can be made is not known, but it will probably be 20 or more years in the future.

Shelterwood Cutting

Four compartments are managed under shelterwood programs, with two scheduled for 5-year cutting cycles and two for 10-year cycles. The early cuttings are primarily for improvement. Unwanted species and trees with poor vigor or low quality, regardless of species, are harvested or killed. White pine crop trees are selected; they are pruned and released by improvement cutting or thinning.

Later cuttings are mostly thinnings to maintain the growth of the crop trees and of the stand generally. Reproduction cuttings by the shelterwood method begin when the stand is 60 or more years old. The seedbed may be scarified, but if reproduction is slow the area may be planted. The final removal cutting is not made until reproduction is well established.

Hardwoods that compete with white pine reproduction are controlled as necessary. Pre-merchantable thinnings may be made in the new stand during its early years. Then the whole cycle is repeated.

In 1953 and 1954, two compartments received improvement cuttings; the products were 1,900 board-feet and 4.5 cords per acre. The stumpage value averaged $38 per acre. In 1955 a hurricane salvage cutting was made on one of these; it produced an additional 2,000 board-feet per acre having a stumpage value of $45 per acre. These compartments will receive another improvement cutting in 1962-63.

The other two compartments had reached the stage for reproduction cuttings when the study began. In one of these an average of $10 per acre has been spent to control hardwoods prior to the reproduction cutting scheduled for 1959. In the other, the first reproduction cutting was made in 1952; it yielded 3,600 board-feet and 4.9 cords per acre, worth $76 in stumpage. In 1955 hurricane salvage in this compartment yielded an additional 3,300 board-feet per acre with a stumpage value of $83. This compartment's next reproduction cutting will probably be made in 1960. In the meantime, hardwoods are being controlled where pine reproduction is already established.

Patch Cutting

Two compartments are reproduced by clear-cutting patches of timber of about ¼ acre; additional patches are cut at 10-year intervals. On two other compartments, patches are smaller but cuttings are made at 5-year intervals. Numbers and sizes of patches are calculated to allow approximately equal volumes of wood to be harvested at regular intervals.

Understory growth on each patch is controlled and, if necessary, the seedbed may be scarified. At the same time appropriate liberation cuttings, improvement cuttings, prunings, and thinnings are made on other parts of the compartment, as described under Shelterwood Cutting.

From 1952 to 1957, patches were cut in the lowest-value portions of all four compartments. Products averaged 636 board-feet and 1.4 cord per acre. The stumpage value averaged $11.40 per acre. In one compartment about $5.50 per acre was spent to make patches in unmerchantable hardwood stands near a seed source. On all patches, hardwood sprouts have been controlled with chemicals.

Strip Cutting

One compartment is reproduced by progressive strip cutting at 10-year intervals. The strips, about 75 feet wide, have their long axis perpendicular to the prevailing winds. Each new strip cut is to the windward of the one cut previously.

As in the patch cuttings, the openings created are treated to control understory growth and the seedbed may be scarified. The necessary liberation, improvement, pruning, and thinning treatments are carried out in adjoining strips at the same time.

The first strip was cut in 1956. It yielded 2,100 board-feet and 0.5 cord per acre. The stumpage value was $47 per acre. The next strip is scheduled for cutting in 1966.

Comparisons of management systems are necessarily lengthy studies. Inventory records are kept to show changes in stand composition and growth. Financial records disclose cost of various operations and receipts from logging. These records take on increasingly greater significance as repeated cuts and other stand treatments are made over a period of several decades.

OTHER MANAGEMENT PROJECTS

Pest Control

Silviculture and economics are not the only considerations in forest management; another is pest control. For example, the good seed crops necessary to start new stands occur only at infrequent intervals, apparently because insects kill the young cones or destroy immature seed. If these insects could be controlled, new stands could be started when needed and less work would be required to maintain seedbed conditions in anticipation of seed crops. Measures for control of cone insects are now being tested.

An insect causing more obvious loss is the white pine weevil, whose larvae feed on, and frequently kill, terminal shoots. Lateral branches replace the damaged shoots, resulting in crooked and forked trees. The lumber value of such trees is much less than that of straight single-stemmed trees.

Pest control is important in white pine management. This young white pine has been damaged by the white pine weevil, now the tree's worst enemy.

In the woodlot experiment, an annual cutting of mature trees is made ...

... and thrifty, well-spaced trees are saved for future cuttings.

A thinning test in a natural stand about 30-35 years old. Above: the stand before thinning; it had about 3,200 pine stems per acre.

Right: the same stand after it had been thinned to about 1,200 stems per acre. Thinning should have been done much sooner.

Woodlot Management

Bettering management of small timber holdings is one of the challenging problems in the white pine region. More than one-fourth (27 percent) of the commercial forest land in New England is in ownerships of less than 100 acres. The average is 39 acres.

A 50-acre tract of the Experimental Forest is being managed as a woodlot. About 35 acres are in white pine with an average volume of 15,000 board-feet per acre. (The other 15 acres are in young unmerchantable stands, and in swamp.) The denser clumps of pine in the merchantable stands are thinned to improve growth of the remaining trees; red maple and other less valuable hardwoods are cut for pulpwood. These practices, together with chemical control of unmerchantable hardwood growth, release pine saplings and improve conditions for new seeding to pine.

Every year the equivalent of the year's growth on the entire tract is harvested as sawlogs and pulpwood. Since the first cut was made in 1950, the average annual cut has been 19,000 board-feet of sawlogs and 13 cords of pulpwood. About 30-man days a year are spent in logging and stand improvement. The average value of the products from these cuts, at roadside, has been $760 per year.

Other Research Projects

Various lesser studies have been undertaken on the Massabesic. The results provide useful guides for management operations and serve as aids in developing more comprehensive studies. For instance, results of five short-term planting studies were used to develop successful reforestation methods for the burned-over land. Two small studies now in progress are described here.

Response Of Young Pine Seedlings To Release

Four-year-old white pine seedlings were released by cutting hardwood competitors in 1952. The release was maintained for 3 years. In 1956 part of the area was given an aerial application--by helicopter--of 2,4,5-T. Practically all pine seedlings responded to release; the greatest response was shown by seedlings that had been under the stiffest competition. Reduction of both root and top competition, as obtained with silvicides, is better than mere crown release.

Thinning Tests
In Pine Sapling Stands

In 1956 and 1957, thinnings were made in two 30-year-old plantations of mixed red and white pines. Half the trees were cut. Those left were pruned. A 9-year-old plantation also was thinned, removing about half of the trees. In addition, we thinned two natural stands, one 8-years-old, the other 30-35 years old. The operation in the older stand reduced the number of pine stems from about 3,200 to 1,200 per acre; this is the first of a scheduled series of thinnings. As a future check on results, a part of each of these natural stands was left undisturbed. These trial thinnings should indicate the approximate age at which first treatments are needed.

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Research on the Massabesic Experimental Forest, as at the other Forest Service field laboratories in the Northeast, is designed to provide the basis for improved forest management, better timber crops, and increased income from the land. Some results can be evaluated quickly and put to immediate use by landowners. The acceptance of helicopter sprays of 2,4,5-T to improve forest stands is a good example. Findings of other experiments may take more time to evaluate, but eventually they too provide for better forestry practices.

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